Marked-Up Version of Substitute Specification

~~Description~~

PRODUCTION OF A COMPLETE IMAGE BY SCANNING PARTIAL AREAS OF A PATTERN

BACKGROUND

The ~~invention~~ present disclosure relates to a method ~~according to the preamble of Claim 1~~ for producing a resulting image from a plurality of individual images.

Such a method can, for example, be used to obtain a panoramic image, or ~~also~~ to scan documents.

The solid angle given by a camera and objective, ~~which~~that is scanned or recorded by an image, is in many situations inadequate for completely recording objects from the surroundings. ~~The use of~~ In particular, the use of wide-angle objectives to completely record objects is not always possible, or always desired. Because of the characteristics of ~~the~~ lenses, a very wide-angle objective causes extreme distortions at the edges of the image ~~which~~ that interfere considerably with the impression. Furthermore, the quality of the display of the object ~~display~~ is disturbed by the limited sensor resolution. In addition, in many cases, ~~however,~~ replacement of the lens or of the objective is not possible ~~either~~, because ~~this~~ the component is firmly integrated into the camera.

Many previous methods ~~have already been used which~~ have attempted to ~~dealt~~ with a similar subject. ~~The focus of the observation here was frequently on~~related to the generation of panoramic images. ~~To~~ correcting the sensor defect. ~~H~~However, the known previous methods for generating images of a larger field of vision require very expensive and complex arithmetical operations that cannot be performed in real time video ~~time~~ to correct the lens and image distortion. For this reason, a calculation of an image with an extended field of vision can generally only be performed offline ~~as a rule~~.

The images used to generate the resulting image of the previous methods only require a slight overlap ~~in this method~~ in the individual images. In ~~this~~ those cases, two adjacent images or two consecutive images contain only a little common

image information. Furthermore, ~~D~~depending on the environment~~, however~~, the images ~~therefore integrally~~may contain quite different lighting conditions. Therefore, as a result of ~~A~~an aperture control on the camera, ~~however, results in~~there will exist extremely varied illuminations at the spliced edges of the resulting image, ~~which~~ that can likewise only be harmonized ~~again~~ at a very great cost.

Fax equipment and flatbed scanners enable the electronic transmission of documents which are available on paper. In many situations ~~the availability of~~ this type of equipment is not available, for example, during a meeting~~, is not always guaranteed~~. An alternative to the use of a fax machine or a flatbed scanner is such a situation is a digital camera, with which the image information can ~~also~~ be saved in digital form. However, the resolution of standard commercial cameras is not yet sufficient to produce adequate resolution for a document in a single exposure.

The scanning of documents by means of many individual images close up to the document to increase the resolution is a known approach. Until now, however, there have only been a few, in part, very unstable methods that can be used to compose a two-dimensional complete image from the individually recorded images ~~again~~.

Most of these methods are based on the image information ~~at~~ first being distorted at an initial processing stage by highly complex arithmetical operations. Then, a~~A~~t a subsequent processing stage, the adjacent image information is ~~then~~ harmonized with the adjacent images in all four edge directions. Each image is corrected both horizontally and vertically in relation to the adjacent images. The images, therefore, only require a slight overlap ~~for~~ to accomplish this. ~~Each image is corrected both horizontally and vertically in relation to the adjacent images.~~ Besides the scarcely tolerable high calculation time, these methods frequently lead to rhombic distortion of the image information which distracts the observer greatly, as shown, for example, in ~~(cf.~~ Figure 1~~)~~. On account of their complexity, the known methods can ~~frequently~~ generally only be performed interactively, and offline.

SUMMARY

The ~~object of the invention~~present disclosure ~~is~~ relates to ~~indicate~~ a method ~~of the type mentioned at the beginning which~~for providinges a high-quality resulting image from a plurality of individual images, without a great amount of calculation.

~~This object is achieved~~An example of the method for producing a resulting image from a plurality of individual images according to the ~~invention~~ present disclosure comprises producing the plurality of individual images using a scanning movement, offsetting the individual images in relation to each other, obtaining image information from the individual images as a function of the offsetting, and producing the resulting image using the obtained image information.~~by the features indicated in Claim 1~~.

Some benefits of ~~T~~the method according to the ~~invention~~ present disclosure include ~~has the following advantages:~~

the ~~R~~rapid processing of the images to produce a resulting image,

elimination of the need to ~~C~~correct~~ion~~ ~~of~~ the lens errors or mapping errors in the image ~~involving~~ utilizing intensive calculations ~~is not necessary~~,

elimination of the need to ~~H~~harmonize~~ation~~ ~~of~~ the illumination at the spliced edges ~~is rendered unnecessary by virtually continuous image scanning~~, and

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~~C~~ontrolling ~~of~~ the ~~additional~~ image information as a function of the ~~image misalignment~~offsetting.

~~The invention is described in more detail hereinafter with reference to an exemplary embodiment shown in the diagram. The diagram shows:~~

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows an example of ~~———~~a ~~complete~~ resulting image prepared from individual exposures ~~————————~~according to the prior art~~;~~.

Figure 2 shows an example of ~~———~~a resulting image generated by scanning the surroundings~~;~~.

Figure 3 illustrates an example of—a scanning movement for scanning a document~~;~~.

Figure 4 illustrates an example of—the image recorded during the scanning movement according to Figure 2~~;~~.

Figure 5 illustrates an example of—the result of successive one-dimensional scans~~, and~~.

Figure 6 illustrates an example of—the resulting image according to the ~~method according to the invention~~present disclosure.

DETAILED DESCRIPTION OF THE PRESENT EXAMPLES

The method according to the ~~invention~~ present disclosure is based on the production of individual images which are generated during a one- or two-dimensional scanning movement.

According to the ~~invention~~ present disclosure individual images are generated which overlap each other to a high degree. This produces a ~~complete~~ resulting image with almost no distortions ~~which~~ that covers a very large solid angle. ~~The method~~This also makes it possible, for example, to produce panoramic images or ~~also~~ to scan in documents with a very high resolution.

In doing so, the image sensor operates, for example, at full scanning frequency, so that by slowly swiveling across the object to be recorded, adjacent images are only slightly offset against each other. From each image, a part of the undistorted image information is copied from the center of the image into a resulting image. The size of the copied ~~picture~~ portion detail is controlled as a function of the calculated offset to the previous image. As two adjacent images overlap to a very high degree, the images have almost identical lighting conditions so that when adjacent edges are put together, as a rule no harmonization of the illumination is necessary.

~~To perform~~An embodiment of the method according to the ~~invention~~present disclosure could, for example, be used with a mobile telephone having a ~~with the following components is used:~~

~~C~~camera module ~~on the reverse of the mobile telephone~~ for recording images from the surroundings,

~~P~~a processor for processing ~~the~~ image data and for generating the resulting image (i.e., estimate of movement, image composition, etc.), and a

~~D~~display for displaying the resulting image. ~~display~~

~~The function to~~ An example of generating ~~e~~ the resulting image ~~(cf. also~~as shown in, for example, Figure 2,~~)~~ on the basis of an image sequence, ~~essentially comprises~~includes ~~the following~~ processing ~~stages:~~the

~~E~~estimation ~~e~~ of movement of two adjacent images, as well as the

~~S~~structure of the resulting image.

~~In the following sections the individual processing stages of t~~The above methods are explained in more detail herein with the ~~simplification~~ assumption, for illustrative purposes only, that the scan follows the surroundings one-dimensionally from right to left.~~:~~

Regarding the ~~1)~~ ~~E~~estimation ~~e~~ of movement of two adjacent images,

~~T~~the movement ~~of two adjacent images~~ is determined, for example, according to ~~the~~ a MSE (Mean Squared Error) method. In the MSE ~~is~~ method, the best possible match in a local neighborhood to the previous image is sought for an image area of the initial image. The best match provides the displacement vector of the two images relative to each other.

Regarding the ~~2)~~ ~~U~~structuring of ~~pdating~~ the resulting image,

~~O~~using ~~n the basis of~~ the displacement vector, the position inside the resulting image to which the additional image information is copied is ascertained. The width of the ~~additional picture~~copied portion detail of the initial image is provided by the offset of the images in the direction of scanning, for this example in the horizontal direction from right to left (i.e., direction x). In this way no gap arises between the ~~picture~~ copied portion detail already put together and the added ~~picture~~ copied portion detail. ~~Vertical~~ Perpendicular to the direction of scanning (i.e., direction y), the complete image information is taken into account. The result of the processing of many images according to this method can be seen, for example, in Figure 1.

~~In a development of the method a~~According to the ~~invention~~present disclosure, scanning of the document takes place by means of a zigzag movement

of the camera across the document at a constant distance, as shown in, for example, ~~(cf.~~ Figure 3~~)~~. In order to avoid variations in the distance to the document and consequently changes in the size of the images during the scanning process, for example, the camera is guided across the document on a frame with the camera pointing ~~vertically~~ downwards towards the document to be scanned. By analyzing the movement of consecutive images, the two-dimensional scan is separated into several one-dimensional (i.e., horizontal) scans as shown, for example, in ~~(cf.~~ Figures 4 and 5~~)~~. Each one-dimensional scan shows a horizontal, undistorted strip of the original document. By separating the two-dimensional scan into several one-dimensional scans, the ~~problem of~~ document generation task is reduced to horizontal scaling of the image strips, and the putting together of the horizontal strips in a vertical direction, as shown, for example, in ~~(cf.~~ Figure 5~~)~~. By ~~L~~linearly scaling ~~of~~ all of the image information, ~~avoids~~ rhombic distortions are avoided in the complete resulting image, as occurs in traditional previous methods, as shown in, for example, ~~(cf.~~ Figure 6~~)~~.

It should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the present invention and without diminishing its intended advantages. It is therefore intended that such changes and modifications be covered by the appended claims.

~~Abstract~~

ABSTRACT

The ~~invention~~ present disclosure relates to a method for ~~obtaining~~ producing a resulting image from a plurality of individual images. The method includes ~~using~~ producing a plurality of individual images ~~which can be successively produced during~~using a scanning movement~~.~~. ~~According to the invention, the successive~~ and offsetting the individual images ~~are slightly offset~~ in relation to each other~~,~~; ~~and~~ The method further includes obtaining image information ~~is obtained~~ from the individual images according to the ~~misalignment~~ offsetting, and ~~copied into the~~producing the resulting image using the obtained image information.

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of claims:

Claims 1-2 (cancelled).

Claim 3 (new): A method for producing a resulting image from a plurality of individual images, the method comprising:

producing the plurality of individual images using a scanning movement;

offsetting the individual images in relation to each other;

obtaining image information from the individual images as a function of the offsetting; and

producing the resulting image using the obtained image information.

Claim 4 (new): The method as defined in claim 1, wherein the scanning movement is two-dimensional.

REMARKS

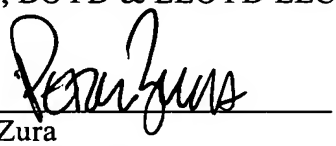
The present amendment makes editorial changes and corrects typographical errors in the specification, which includes the Abstract, in order to conform the specification to the requirements of United States patent practice. No new matter is added thereby. The present amendment also includes a Substitute Specification including a marked-up version of the changes made to the specification by the present amendment.

In addition, the present amendment cancels original claims 1-2 in favor of new claims 3-4. Claims 3-4 have been presented solely because the revisions by red-lining and underlining that would have been necessary in claims 1-2 in order to present these claims in accordance with preferred United States patent practice would have been too extensive and burdensome. The present amendment is intended for clarification purposes only and not for substantial reasons related to patentability pursuant to 35 U.S.C. §§101, 102, 103 or 112. Indeed, the cancellation of claims 1-2 does not constitute an intent on the part of the Applicants to surrender any of the subject matter of claims 1-2.

Early consideration on the merits is respectfully requested.

Respectfully submitted,

BELL, BOYD & LLOYD LLC

BY 

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